WICHITA STATE UNIVERSITY

Program Review Self-Study Template

Academic unit: Department of Chemistry

College: Fairmount College of Liberal Arts and Sciences

Date of last review 2012

Date of last accreditation report (if relevant) 2014

List all degrees described in this report (add lines as necessary)

Degree:	BS Chemistry	CIP* code:	40.0501
Degree:	MS Chemistry	CIP code:	40.0501
Degree:	PhD Chemistry	CIP code:	40.0501

*To look up, go to: Classification of Instructional Programs Website, http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55

Faculty of the academic unit (add lines as necessary)

Name	Signature
Dr. James G. Bann (Associate Professor)	
Dr. Moriah R. Beck (Associate Professor)	
Dr. Dennis H. Burns (Professor)	
Dr. David M. Eichhorn (Professor)	
Dr. Douglas S. English (Associate Professor)	
Dr. Maojun Gong (Assistant Professor)	
Dr. William C. Groutas (University Distinguished Professor)	
Dr. Katie Mitchell-Koch (Assistant Professor)	
Dr. D. Paul Rillema (Professor)	
Dr. Alexandre A. Shvartsburg (Assistant Professor)	
Dr. Kandatege Wimalasena (Professor)	

Submitted by: David M. Eichhorn, Professor and Chair Date March 27, 2015
(name and title)

In yellow highlighted areas, data will be provided

1. Departmental purpose and relationship to the University mission (refer to instructions in the WSU Program Review document for more information on completing this section).

a. University Mission:

The mission of Wichita State University is to be an essential educational, cultural, and economic driver for Kansas and the greater public good.

b. Program Mission (if more than one program, list each mission):

The mission of the undergraduate program in Chemistry is to provide students with a broad understanding of all disciplines in chemistry, to train them in the specific skills required for chemical research and to prepare them for careers in the chemical or chemistry-related industry, for advanced study in chemistry, or for pursuit of professional degrees.

The mission of the Masters of Science program in Chemistry is to provide students with advanced understanding of chemistry, to develop their technical research and analytical skills, and to prepare them for careers in the chemical or chemistry related industry, for teaching careers in chemistry, and for further study in chemistry at the doctoral level.

The mission of the PhD program in Chemistry is to provide students with an in-depth expertise in a specific area of chemistry, to develop the ability to conceive of and carry out an independent research program, and to prepare students for senior-level careers in industry or academic careers at research institutions.

c. The role of the program (s) and relationship to the University mission: Explain in 1-2 concise paragraphs.

The Baccalaureate degree programs in the Department of Chemistry are designed to provide students with a solid background in all areas of chemistry, including organic, analytical, inorganic, physical, and biochemistry. Through traditional coursework, extensive laboratory experience, and independent study research projects, students are provided with the conceptual knowledge base, introduced to the principles of the scientific method, and given the opportunity to apply these while developing critical thinking and problem solving skills. An undergraduate degree in chemistry will prepare the student for immediate employment in industry, government, or primary or secondary education; careers in chemical-oriented business or law; or graduate study in chemistry, biochemistry, or medical professional schools (including medicine, dentistry, optometry, veterinary).

The Masters of Science program in Chemistry is a strong research-based program designed to provide students with advanced instruction in a variety of chemical disciplines, develop students' technical expertise with chemical instrumentation, and further engage them in state-of-the-art original research. Through a core curriculum of advanced courses and a faculty-mentored research project culminating in a thesis, students are prepared for positions in the chemical and pharmaceutical industry, teaching at the high-school and junior college level, and further study at the doctoral level in chemistry or biochemistry.

The PhD program in Chemistry is designed to provide students with advanced instruction over a broad range of chemical disciplines as well as in-depth instruction in a specific area. The expectation is that the student will become an expert in a specific field of study and will develop the skills required to be an independent researcher, including genesis and development of an idea, formulation of a research strategy, collection and analysis of data, drawing appropriate conclusions, and presentation of results. The degree culminates in the writing and defense of a dissertation based on an original research project. Recipients of the PhD are prepared for employment in senior positions in industry and

government, teaching at four-year colleges, and postdoctoral positions leading ultimately to teaching positions at research universities.

d. Has the mission of the Program (s) changed since last review? ☐ Yes ☒ No
   i. If yes, describe in 1-2 concise paragraphs. If no, is there a need to change?

e. Provide an overall description of your program (s) including a list of the measurable goals and objectives of the program (s) (programmatic). Have they changed since the last review?
   ☒ Yes ☐ No
   If yes, describe the changes in a concise manner.

The undergraduate program in Chemistry offers a number of degrees tailored to prepare students for different career or higher education options. The BS in Chemistry is certified by the American Chemical Society and is geared to students intending to seek employment in chemical or chemistry-related industry or those planning to pursue advanced degrees in chemistry. A biochemistry option is available with this degree, which would be attractive to those students intending to pursue advanced degrees in biochemistry. The BS in Chemistry-Premedicine is designed for students intending to pursue advanced degrees in health-related fields, such as medicine, pharmacy, or dentistry. The BS in Chemistry/Business is a joint venture with the Barton School which is designed for students seeking careers in the pharmaceutical or chemical industries. The Field Major in Biochemistry, shared with the Department of Biological Sciences, also prepares students for graduate study in biochemistry and biomedical fields. The department also offers a BA degree in Chemistry.

The objectives for all the undergraduate degrees are to develop a solid foundation in the principles of chemistry including all major subdivisions of the field, to become familiar with the synthetic and analytical techniques of chemistry, and to gain an understanding of the scientific method and application of the principles learned in classes to chemical research. Measurable outcomes include (i) assessment exams taken following completion of most undergraduate courses and (ii) a written report on the independent research project. One significant change to the degree programs, based on an assessment of student need and demand, is that the BS in Chemistry-Premedicine has been revamped to incorporate more courses from biological sciences and health professions in order to better prepare students for medical school.

The MS program in chemistry is a strong, research-based program whose intent is to graduate students who will be employed in the chemical or pharmaceutical industry or teaching positions at the high-school or junior college level, or who will pursue advanced degrees in chemistry. Success in achieving this goal can be measured by the percentage of graduates who have been able to obtain such positions. Based on the data given in section 4b, the program has achieved this goal, with 100% of the graduates having gone on to such positions related to their MS degree (1 employed in chemical industry and 11 studying for advanced degrees). The objectives of this degree are to build on the undergraduate foundation with advanced instruction in a broad range of chemical disciplines and to master the principles and techniques of chemical research. The measurable outcome is the written thesis based on an original research project and the oral defense thereof.

The PhD program in chemistry is intended to graduate students who will establish careers as independent researchers in the chemical industry and in academic positions at four-year colleges and research universities. Success in achieving this goal can be measured by the percentage of graduates who have been able to obtain such positions. Based on the data

given in section 4c, the program has achieved this goal, with 100% of the graduates having gone on to such positions related to their PhD degree (8 postdoctoral positions, 6 academic positions).The objectives of this degree are to acquire expertise in a specific area of chemistry, establish proficiency in the techniques of chemical research, and develop the ability to conceive of, express, and carry out an independent research project. The measurable outcomes are (i) cumulative exams taken in the 2nd and 3rd years, (ii) preparation and defense of an original research proposal in the 5th semester, and (iii) the written dissertation based on an original research project and the oral defense thereof.

2. Describe the quality of the program as assessed by the strengths, productivity, and qualifications of the faculty in terms of SCH, majors, graduates, and scholarly/creative activity (refer to instructions in the WSU Program Review document for more information on completing this section).

Complete the table below and utilize data tables 1-7 provided by the Office of Planning Analysis (covering SCH by FY and fall census day, instructional faculty; instructional FTE employed; program majors; and degree production).

Scholarly Productivity	Number Journal Articles		Number Presentations		Number Conference Proceedings		Performances			Number of Exhibits		Creative Work		No. Books	No. Book Chaps.	No. Grants Awarded or Submitted	$ Grant Value
	Ref	Non-Ref	Ref	Non-Ref	Ref	Non-Ref	*	**	***	Juried	****	Juried	Non-Juried				
Year 1 2015	15			65												26	5.35 M
Year 2 2016	25			65												23	12.3 M
Year 3 2017	22			50												16	6.94 M

* Winning by competitive audition. **Professional attainment (e.g., commercial recording). ***Principal role in a performance. ****Commissioned or included in a collection.

- Provide a brief assessment of the quality of the faculty/staff using the data from the table above and tables 1-7 from the Office of Planning Analysis as well as any additional relevant data. Programs should comment on details in regard to productivity of the faculty (i.e., some departments may have a few faculty producing the majority of the scholarship), efforts to recruit/retain faculty, departmental succession plans, course evaluation data, etc.

  Provide assessment here:

The Department of Chemistry at Wichita State University is a vibrant, research-active department whose primary missions are to enhance and sustain a highly competitive undergraduate and graduate training program in all areas of chemistry and to make significant scholarly contributions to the body of chemical knowledge. All faculty members hold a PhD and have received further postdoctoral training before joining the WSU faculty. All maintain active research programs, all are involved in teaching undergraduate and graduate courses, and all serve on MS thesis and PhD dissertation committees. By its nature, research in chemistry involves student researchers – therefore nearly all publications by a faculty member include one or more student (undergraduate or graduate) or postdoctoral authors. The high level of research activity among the faculty of the Department of Chemistry is important for all three degree programs. An education in chemistry requires engagement in original laboratory research. At the graduate level, this is obvious, since the major portion of the graduate degree (MS or PhD) is the research project, which is carried out in close collaboration with the student's major advisor – students in these programs embark on their final research project no later than their second semester in the program. This is, however, no less true at the undergraduate level – even at institutions without high-level research programs, faculty are encouraged to engage

in research so as to expose their students to this aspect of chemistry. At WSU, participation in undergraduate research is a requirement for all BS chemistry majors and the availability of research programs operating at the highest levels makes this a more fruitful endeavor. Furthermore, given the rapidly changing nature of chemistry, the fact that faculty are operating at the frontiers of chemical research allows them to bring that knowledge back into the classroom – even at the most introductory levels, instruction is informed by the current state of the discipline.

The Department of Chemistry produces a large number of credit hours, primarily due to the service aspects of the General Chemistry, Organic Chemistry, and Biochemistry classes, which are required for many students majoring in other fields or aspiring to professional education in the health professions. Over the past three years, total SCH production has decreased by 8.1%, compared with a larger 9.7% decrease in the university. The 100-299 levels and 500-699 levels show similar comparisons with the university – decreases in SCHin chemistry at somewhat lower percentages. At the 700-999 levels, chemistry shows a 9.4% increase, compared with a 3.8% decrease at the university level. SCH produced by tenure-eligible faculty has remained relatively constant (60-70%) over the three years, although we are still in need of increased levels of tenure-eligible faculty. With respect to majors, the department has experienced a decline in total number of majors over the past 3 years. While this is true of LAS, as a whole, the decline in chemistry majors has been somewhat larger. Some of this decline is due to having increased the rigor of the Chemistry-Premedicine degree, which was done to make this degree a better entrée to graduate studies in chemistry while still being a good degree for students applying to medical school. We have since proposed (and are seeking final approval) a further redesign of this degree which will focus it even more at encompassing all the requirements for medical school, in hopes that this will make it a more popular degree choice. Doctoral degrees have stayed fairly constant at an appropriate level and master's degrees have increased as we encouraged our Ph.D. students to apply for their master's degree prior to advancing to candidacy for the Ph.D.

Research productivity in chemistry is best assessed by an analysis of the papers published in peer-reviewed academic journals. The goal set for faculty members in our department, and a reasonable expectation for an institution such as WSU, is a minimum of one paper per year. Over the current review cycle newer professors have had their research efforts mature, allowing our productivity in terms of published papers to increase, with an average of 1.9 publications per faculty member per year over the last three years and 2.1 publications per faculty member per year over the last two years. All except two faculty members averaged at least 1 publication per year, with the numbers ranging from 0.33 to 4.67 per year. Publications continue to appear in highly regarded high-impact journals, such as *Dalton Transactions*, *Analytical Chemistry*, *Journal of Chemical Theory and Computation*, *Journal of Medicinal Chemistry*, *Journal of Molecular Biology*, *Biochemical Journal*, and *Physical Chemistry Chemical Physics*. The increase from 37 total publications in 2012-2014 to 62 in 2015-2017 can be attributed to some of the younger members of our department having their research efforts reach a level of maturity – the average of 1.9 publications per faculty member per year is in the appropriate range for our program. Faculty members and students are also encouraged to present research findings at regional, national, and international meetings. Such activity not only allows for personal interactions with others in the field, but also brings recognition to the department and the university. WSU always brings a large contingent of graduate and undergraduate students to present at the Midwest Regional Meeting of the American Chemical Society. In addition, presentations were made at prestigious meetings such as the national meetings of the American Chemical Society, the American Society of Mass Spectrometry, Biophysical Society, the Society of Laboratory Automation and Screening, the American Society of Biochemistry and Molecular Biology, and international meetings such as Pacifichem, Pittcon, Gordon Research Conferences, the International Conference on Photochemistry, and the International Chemical and Biological Society. Department faculty members were also invited speakers at regional universities such as the University of Kansas, University of Missouri – Kansas City, Benedictine College, and Oklahoma State University, as well as at other universities around

the country, such as UCLA, University of Washington, University of Southern California, Miami University (Ohio), Virginia Polytechnical Institute, the University of North Texas, and the University of Arkansas.

The other metric by which to assess a research program is that of external funding. All faculty members in the Department of Chemistry have actively pursued external funding during the period of review. External funding in chemistry has become increasingly difficult to achieve. Still, faculty in the WSU Department of Chemistry have maintained a high level of success in securing external funding from federal and state sources (NIH, NSF, NASA, COBRE, KINBRE, etc.). The table below shows the total dollar amounts of grant proposals submitted and funded in the past three years by WSU Chemistry Department faculty members. Also included are total amounts for the previous three years, showing an increase in levels of both submitted and funded grants.

WSU Chemistry Department external grant submission activity, 2015 – 2017 ($)

	submitted	funded	still pending
2015	5,347,709	1,414,843	0
2016	12,281,955	573,511	0
2017	6,943463	604722	4,616,525
Total 2015-2017	24,573,127	2,593,076	4,616,525
Total 2012-2014	17,976,001	1,546,934	1,167,034

Finally, the scholarly standing of the faculty can be addressed by their participation in review of papers and grant proposals and service on editorial boards and as officers in professional societies. Without exception, all the faculty members in the Department of Chemistry are actively engaged in such activities, serving as reviewers for many of the journals and funding agencies listed above. Board and officer positions held by members of the WSU chemistry faculty during the period of review include editorial advisory board member of *The Open Enzyme Inhibition Journal***;** American Chemical Society National Chemistry Olympiad Coordinator for Kansas, American Chemical Society Councilor, member of the American Chemical Society Divisional Activities Committee and Chemical Education Committee, member of the Curriculum Development Committee for the University of Kansas School of Medicine – Wichita; Chair of the Midwest Region of the American Chemical Society, Chair of the Wichita Expanding Your Horizons Conference, and Chair of the American Society of Mass Spectrometry Interest Group in Metal Ions in Mass Spectrometry.

Chemistry faculty members have won awards reflecting distinction in all aspects of their activities. These include: Coleman Fellow, Innovation Celebration Award for Patents (two faculty), Academy for Effective Teaching Award, and Phenomenal Women Award.

The number of tenure or tenure-eligible faculty members in the chemistry department remains below the minimum level consistent with a Ph.D.-granting institution in chemistry. As such, we continue to rely on adjunct, temporary, and non-tenure-eligible faculty to facilitate teaching of lower-level classes. We are fortunate to have been able to obtain highly qualified individuals (all with Ph.D. degrees in chemistry) to teach these classes, ensuring that the quality of instruction for our students has been maintained at a high level. We hope, however, to continue to add faculty members in the next couple of years. We currently have an offer out to a fill a Distinguished Professor position which has been available for a few years, but which we have not been given the permission to advertise until this year.

3. **Academic Program: Analyze the quality of the program as assessed by its curriculum and impact on students for each program (if more than one). Attach updated program assessment plan (s) as an appendix (refer to instructions in the WSU Program Review document for more information).**

a. For undergraduate programs, compare ACT scores of the majors with the University as a whole. Over the period of review, ACT scores of chemistry majors are consistently 2 points above those for the University (25 vs. 23).

b. For graduate programs, compare graduate GPAs of the majors with University graduate GPAs. The GPA for entering graduate students in chemistry is very nearly the same as it is for entering graduate students across the university, consistently 3.4-3.5 for chemistry, as compared to 3.5 for the University.

c. Identify the principal learning outcomes (i.e., what skills does your Program expect students to graduate with). Provide aggregate data on how students are meeting those outcomes in the table below. Data should relate to the goals and objectives of the program as listed in 1e. Provide an analysis and evaluation of the data by learner outcome with proposed actions based on the results.

In the following table provide program level information. You may add an appendix to provide more explanation/details. Definitions:
Learning Outcomes: Learning outcomes are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program (e.g., graduates will demonstrate advanced writing ability).
Assessment Tool: One or more tools to identify, collect, and prepare data to evaluate the achievement of learning outcomes (e.g., a writing project evaluated by a rubric).
Criterion/Target: Percentage of program students expected to achieve the desired outcome for demonstrating program effectiveness (e.g., 90% of the students will demonstrate satisfactory performance on a writing project).
Result: Actual achievement on each learning outcome measurement (e.g., 95%).
Analysis: Determines the extent to which learning outcomes are being achieved and leads to decisions and actions to improve the program. The analysis and evaluation should align with specific learning outcome and consider whether the measurement and/or criteria/target remain a valid indicator of the learning outcome as well as whether the learning outcomes need to be revised.

Undergraduate - BS

Learning Outcomes (most programs will have multiple outcomes)	Assessment Tool (e.g., portfolios, rubrics, exams)	Target/Criteria (desired program level achievement)	Results	Analysis
Demonstrate the ability to apply principles of organic, inorganic, physical (thermo and quantum), analytical (and instrumental), and biochemistry	American Chemical Society exams in each field are administered at the conclusion of the appropriate course	85% of students will demonstrate satisfactory performance on exam by performing within ± one standard deviation of the national norm or above. *	AY15 – Analytical – 80% Instrumental– 88% Organic – 91% Thermo – 82% Quantum – 100% Inorganic – 93% Biochemistry (Chem 661) – 91% (Chem 663) – 82% AY16 – Analytical – 72% Instrumental– 87% Organic – 91% Thermo – 83% Quantum – 100% Inorganic – 100% Biochemistry (Chem 661) – 93% (Chem 663) – 92% AY17 – Analytical – 77% Instrumental– 88% Organic – 84% Thermo – 79% Quantum – 80% Inorganic – 88% Biochemistry (Chem 661) – 66% (Chem 663) – 91%	In general, students are performing at or near the target levels. Only the 2017 Chem 661 class is significantly below the desired level, and other years have acceptable performance on this exam.
Demonstrate the ability to apply techniques and concepts of chemistry in a research project	Research report submitted at the conclusion of the mandatory independent study research course			Quantitative analysis has not been carried out to date, but in the future reports will be analyzed according to AACU Inquiry and Analysis rubric

* Exams are administered at the conclusion of Chem 523 (analytical), Chem 524 (instrumental), Chem 532 (organic), Chem 545 (physical – thermodynamics), Chem 546 (physical – quantum), Chem 615 (inorganic), Chem 661 (biochemistry), and Chem 663 (biochemistry). Chem 523, 524, 532, and 661 contain a large number of non-chemistry majors, rendering results from those exams less useful for assessing the students in the chemistry program. Satisfactory performance is considered those who fall above one standard deviation below the national norms on the exam.

Alignment of the curriculum with student learning outcomes: The chemistry curriculum has been specifically designed to lead towards realization of the identified student learning outcomes. Per the recommendations from the American Chemical Society's Committee on Professional Training, this process begins with one year of General Chemistry (Chem 211/212), which forms the basis for all the succeeding courses in the curriculum, including introducing the fundamental tools and techniques for laboratory work. Each of the subdisciplines identified with student learning outcomes is then introduced with a foundation course (organic – Chem 531, inorganic – Chem 514, physical – Chem 545, analytical – Chem 523, and biochemistry – Chem 661 or Chem 662). Depending on the degree pursued, students then progress to in-depth classes in 3 – 5 of these areas (organic – Chem 532, inorganic – Chem 615, physical – Chem 546, analytical – Chem 524, and biochemistry - Chem 663). Advanced laboratory instruction is also pursued, either as part of the lecture courses (organic, analytical) or as a separate course (inorganic – Chem 616, physical – Chem 547, biochemistry – Chem 664). The culmination of study is the independent research project, which draws on the student's in-class and laboratory studies.

Graduate - MS

Learning Outcomes (most programs will have multiple outcomes)	Assessment Tool (e.g., portfolios, rubrics, exams)	Target/Criteria (desired program level achievement)	Results	Analysis
Demonstrate the ability to communicate chemical concepts orally	Oral communication rubric analysis of two presentations in Chem 700	80% of scores for each component of the rubric will be very good or excellent	We have not yet initiated this analysis and will do so in the near future.	All students successfully complete one semester of Chem 700.
Demonstrate the ability to communicate chemical concepts in written form	Written communication rubric analysis of thesis based on original research	80% of scores for each component of the rubric will be very good or excellent	We have not yet initiated this analysis and will do so in the near future.	
Demonstrate proficiency at carrying out and analyzing chemical research	Written thesis based on original research and defense thereof	100% successful defense of thesis	100% of students defending thesis have passed	MS students are successfully achieving this outcome.

Graduate - PhD

Learning Outcomes (most programs will have multiple outcomes)	Assessment Tool (e.g., portfolios, rubrics, exams)	Target/Criteria (desired program level achievement)	Results	Analysis
Demonstrate the ability to communicate chemical concepts orally	Oral communication rubric analysis of departmental research presentation	80% of scores for each component of the rubric will be very good or excellent	We have not yet initiated this analysis and will do so in the near future.	All students successfully complete their departmental presentation.
Demonstrate the ability to communicate chemical concepts in written form	Written communication rubric analysis of original research proposal	80% of scores for each component of the rubric will be very good or excellent	We have not yet initiated this analysis and will do so in the near future.	All students successfully complete their research proposal.
Demonstrate proficiency at carrying out and analyzing chemical research	Written dissertation based on original research and defense thereof	100% successful defense of dissertation	100% of students defending dissertation have passed	PhD students are successfully achieving this outcome.
Demonstrate ability to conceive of a research project	Written Original Research Proposal and defense thereof – completed during fifth semester	100% successful defense of proposal	100% of students defending proposal have passed – a few required a second defense	PhD students are successfully achieving this outcome.
Demonstrate ability to read and analyze current chemical literature	Cumulative examinations – students are required to pass 5 exams in two years starting in student's third semester	100% pass rate	100% of students have passed required number of exams.	PhD students are successfully achieving this outcome.

d. Provide aggregate data on student majors satisfaction (e.g., exit surveys), capstone results, licensing or certification examination results (if applicable), employer surveys or other such data that indicate student satisfaction with the program and whether students are learning the curriculum (for learner outcomes, data should relate to the outcomes of the program as listed in 3c).

Evaluate table 10 from the Office of Planning and Analysis regarding student satisfaction data. Satisfaction among undergraduate chemistry students rebounded in 2015 from the drop experienced between 2013 and 2104, but then dropped a bit again in 2017. Overall, satisfaction remained in the 70-80% range, placing it significantly above the levels for the college division, but slightly below those for the university. Among graduate students, satisfaction was 100% for 2015 and 2016 and 80% for 2017, clearly indicating satisfaction with the program.

Learner Outcomes (e.g., capstone, licensing/certification exam pass-rates) by year, for the last three years				
Year	N	Name of Exam	Program Result	National Comparison±
1		N/A		
2		N/A		
3		N/A		

e. Provide aggregate data on how the goals of the *WSU General Education Program* and *KBOR 2020 Foundation Skills* are assessed in undergraduate programs (optional for graduate programs).

Outcomes: ○ Have acquired knowledge in the arts, humanities, and natural and social sciences ○ Think critically and independently ○ Write and speak effectively ○ Employ analytical reasoning and problem solving techniques	Results	
	Majors	Non-Majors
Write effectively and think critically and independently – all BS Chemistry, BS Chemistry – Biochemistry option, BS Chemistry – Pre-medicine, and Biochemistry field major students are required to submit a final report describing their undergraduate research project. This report will be assessed according to the AACU Written Communication and Critical Thinking rubrics	Reports have not been assessed in this manner in the past – we will start to do this.	
Have acquired knowledge in the natural sciences – Nationally normed ACS exams are administered in many chemistry classes which measure students' knowledge of the material compared with students across the country. The upper division classes, with the exception of Chem 531/532 (organic chemistry) and 661 (biochemistry), contain mostly chemistry majors and can serve to quantify the requirement for this group. General Chemistry classes contain mostly non-majors and can serve to quantify the requirement for this group.	Results of these exams are given in section 3c and show that chemistry majors are generally satisfying this requirement.	AY15 – Chem 103 – 100% Chem 211 – 62% Chem 212 – 77% AY16 – Chem 103 – 98% Chem 211 – 83% Chem 212 – 71% AY17 – Chem 103 – 100% Chem 211 – 77% Chem 212 – 76%

Note: Not all programs evaluate every goal/skill. Programs may choose to use assessment rubrics for this purpose. Sample forms available at: http://www.aacu.org/value/rubrics/

f. For programs/departments with concurrent enrollment courses (per KBOR policy), provide the assessment of such courses over the last three years (disaggregated by each year) that assures grading

standards (e.g., papers, portfolios, quizzes, labs, etc.) course management, instructional delivery, and content meet or exceed those in regular on-campus sections.
Provide information here: The department had a concurrent enrollment relationship for the teaching of General Chemistry with a number of local high schools. When the university chose to discontinue concurrent enrollment, some of these chose to establish relationships with other colleges. The LAS Dean's office is currently in discussions with some schools to establish/re-establish concurrent enrollment.

g. Indicate whether the program is accredited by a specialty accrediting body including the next review date and concerns from the last review.
Provide information here:

The department is not accredited, per se. However, the Bachelors of Science degree in Chemistry and the BS Chemistry - ACS Biochemistry degree are *certified* by the American Chemical Society. In addition, the department is reviewed by the American Chemical Society every five years. The last review was submitted in June, 2014. Results from this review were positive, with a commendation for the department's rigorous course materials and a statement that we have a "solid undergraduate program." Two comments were made, one being a suggestion that the use of chemical literature be more emphasized in the curriculum and the second being a concern (repeated from the previous review) that too few faculty sabbaticals were taken. As indicated in our last review, this is partially due to the current makeup of our department, which did not include many mid-career type faculty members. This is being addressed, as two faculty members have been approved for sabbatical leave in AY19. The next review by ACS is due in 2020.

h. Provide the process the department uses to assure assignment of credit hours (per WSU policy 2.18) to all courses has been reviewed over the last three years.
Provide information here: The Department Chair has reviewed credit-hour assignment to ensure that it corresponds to the university policies.

i. Provide a brief assessment of the overall quality of the academic program using the data from 3a – 3e and other information you may collect, including outstanding student work (e.g., outstanding scholarship, inductions into honor organizations, publications, special awards, academic scholarships, student recruitment and retention).
Provide assessment here:
The data above show that, for the most part, students are very satisfied with the education they receive as Chemistry majors at WSU and that they are successful in achieving their learning objectives. A major change that we have made in the past three years is replacement of published lab manuals for General Chemistry with ones written in-house. This results both in labs that better follow our own curriculum and in a substantially reduced price for the students.

An additional metric by which to assess the quality of the programs is through an analysis of the participation of students (undergraduate and graduate) in written and oral presentation of research results. Due to the nature of the discipline, original research is by far the best way to incorporate the material learned in the classroom and in organized labs. The MS and PhD curricula are centered around the original research project – all students in these programs begin their research projects no later than

their second semester in residence. This is common in most MS and PhD programs in chemistry. At the undergraduate level, the American Chemical Society recommends undergraduate research and such an experience is widely viewed as a valuable component of an undergraduate chemistry degree. However, many institutions do not require it for the degree and are not able to provide this experience for all of their students. At WSU, all BS degrees in chemistry require a minimum of one semester of undergraduate research, in which students work closely with a faculty member (and often a graduate student or postdoc) on an original research project.

In item 2a were listed the number of journal articles and research presentations submitted by faculty in the Department of Chemistry. Almost all of these include at least one student author – either undergraduate or graduate. Each year the Chemistry Department contributes on the order of 15-20 presentations (oral or poster) to the Midwest Regional meeting of the American Chemical Society – the majority of these not only include student authors, but are presented by students. In the past three years, undergraduate and graduate students have presented papers at regional conferences such as the Kansas Physical Chemistry Symposium, the Kansas IDEA Network for Biomedical Research Excellence (KINBRE) Symposium, and the University of and the University of Kansas GRASP-NMR Symposium as well as national meetings of the American Chemical Society, the American Society for Mass Spectrometry, and the NIH Institutional Development Awards program. Chemistry students are also well represented at campus research events (URCAF and GRASP). Over the past 3 years, chemistry students have: (i) been selected to present at the Capital Graduate Research Summit, (ii) been awarded three of the first four Sarachek awards for Scholarly Excellence in the Natural Sciences, (iii) won 2nd place in the WSU Undergraduate Research and Creative Activities Forum, (iv) won 1st place in the Oklahoma Pentasectional ACS meeting poster competition, and (v) won awards for presentations at the statewide K-INBRE symposium. In addition, we recognize each year a number of outstanding students, many via awards provided by the American Chemical Society.

4. Analyze the student need and employer demand for the program. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

a. Evaluate tables 11-15 from the Office of Planning Analysis for number of applicants, admits, and enrollments and percent URM students by student level and degrees conferred. The data show that slightly over 50% of applicants to the chemistry graduate programs are admitted to the programs, which indicates a good level of selectivity. Data on underrepresented minorities in the undergraduate program are largely in line with the data for the university and the college. For the chemistry graduate programs, the number of underrepresented minorities is quite small, as the vast majority of our graduate students are foreign.

b. Utilize the table below to provide data that demonstrates student need and demand for the program.

Undergraduate - BS

Employment of Majors*							
	Average Salary	Employ-ment % In state	Employment % in the field	Employment: % related to the field	Employment: % outside the field	No. pursuing graduate or profes-sional educa-tion	Projected growth from BLS** Current year only. ↓
Year 1		83	50	33	17	10	
Year 2		100	67	33	0	6	
Year 3		100	38	13	50	5	

* May not be collected every year

** Go to the U.S. Bureau of Labor Statistics Website: http://www.bls.gov/oco/ and view job outlook data and salary information (if the Program has information available from professional associations or alumni surveys, enter that data)

- Provide a brief assessment of student need and demand using the data from tables 11-15 from the Office of Planning and Analysis and from the table above. Include the most common types of positions, in terms of employment graduates can expect to find.

Provide assessment here:

Graduates with the BS in chemistry are prepared for a number of different career/educational paths. Many recent graduates from the WSU Chemistry Department have gone on to graduate school in chemistry, both at WSU and at other institutions such as the University of Kansas, Kansas State, Washington State, and the University of Michigan. Other graduates have gone on to professional schools in medicine, veterinary medicine, dentistry, and pharmacy. Graduates have also gone on to employment in industry - recent graduates have had success in obtaining positions in the pharmaceutical chemistry industry and in medicine-related fields. All students graduating with a bachelor's degree in chemistry complete an exit survey and exit interview with the department chair – they also complete the university's exit survey. Unfortunately, students at that point do not always know where they are headed next. In order to get a better idea of immediate post-graduation placement, an attempt was made using internet searches, Facebook, and LinkedIn to determine such information. Data were obtained for over 50% of graduates from 2015-2017. Of those students, half had been accepted to graduate school in chemistry or biochemistry or to professional schools and half were employed. Of those employed, 49% had jobs directly related to their chemistry degree, 39% had jobs somewhat related to their degree, and 12% had jobs unrelated to their chemistry degree. In addition, 95% of employed graduates had jobs in the state of Kansas, with most of them in Wichita. To obtain a longer view of our graduates' employment, we

conducted a survey of all alumni since 1960. The response was not great and we plan to try again to get a greater return. However, of those who responded, 88% of those with bachelor's degrees continued on to graduate school or reported their first job to be directly related to their chemistry degree; 71% reported their most recent job to be directly related and 24% reported their most recent job to be somewhat related. Taken as a whole, these data suggest that there is significant demand for graduates with chemistry degrees in Wichita and surrounding areas and that our graduates have been successful in obtaining these positions.

Graduate - MS

Employment of Majors*							
	Average Salary	Employ-ment % In state	Employment % in the field	Employment: % related to the field	Employment: % outside the field	No. pursuing graduate or profes-sional educa-tion	Projected growth from BLS** Current year only.
Year 1		0	0	0	0	3	
Year 2		0	0	0	0	6	
Year 3		0	100	0	0	2	

* May not be collected every year

** Go to the U.S. Bureau of Labor Statistics Website: http://www.bls.gov/oco/ and view job outlook data and salary information (if the Program has information available from professional associations or alumni surveys, enter that data)

- Provide a brief assessment of student need and demand using the data from tables 11-15 from the Office of Planning and Analysis and from the table above. Include the most common types of positions, in terms of employment graduates can expect to find.

Students obtaining MS degrees in chemistry from WSU have been very successful in obtaining employment in chemistry or related fields or admission to programs for further education in chemistry. Over the past three calendar years, only two students have completed terminal MS degrees – they are listed below with their placement. Some students who entered the terminal MS program chose to switch to the Ph.D. program. The remaining 11 MS degree recipients received a MS degree upon advancement to candidacy for the PhD.

2018 (degree pending, all requirements completed) Andrew Bowman - PhD program, University of Maastricht
2017 Julia Kaszycki – Application Chemist, Excellims Corporation, Acton, MA

Graduate - PhD

Employment of Majors*							
	Average Salary	Employ-ment % In state	Employment % in the field	Employment: % related to the field	Employment: % outside the field	No. pursuing graduate or profes-sional educa-tion	Projected growth from BLS** Current year only.
Year 1		0	100	0	0	0	
Year 2		20	100	0	0	0	
Year 3		33	100	0	0	0	

* May not be collected every year

** Go to the U.S. Bureau of Labor Statistics Website: http://www.bls.gov/oco/ and view job outlook data and salary information (if the Program has information available from professional associations or alumni surveys, enter that data)

- Provide a brief assessment of student need and demand using the data from tables 11-15 from the Office of Planning and Analysis and from the table above. Include the most common types of positions, in terms of employment graduates can expect to find.

Students obtaining PhD degrees in chemistry from WSU have been very successful in obtaining postdoctoral positions or employment in chemistry or related fields. Graduates from the PhD program in the past three years went on to the following positions:

2018 Chandana Kasireddy – Postdoc, National Institute of Environmental Health Sciences
2017 Vishnu Damalanka – Postdoc, Washington University of St. Louis
2017 Ravi Vattepu – postdoc, Harvard University Medical School
2017 Nilmini Senaratne – chemistry instructor, The Independent School, Wichita, KS
2017 Jayangika Dahanayake – postdoc, Wichita State University
2017 Anushka Chathuranga – postdoc, Scripps Institute, La Jolla, CA
2016 Sumudu Mapa – postdoc, US Food and Drug Administration
2016 Qiyang Zhang – Assistant Professor, Emporia State University
2016 Pathum Weerawarna – postdoc, Northwestern University
2016 Lava Kadel – Visiting Assistant Professor, Grand Valley State University
2016 Archana Mishra – lecturer in chemistry, Humboldt State University
2015 Viet Le – Assistant Professor, Rochester Institute of Technology
2015 Ritu Gurung – Assistant Professor, St. Ambrose University
2015 Chamila Kadigamuwa – postdoc, US National Institutes of Health

5. **Analyze the service the Program provides to the discipline, other programs at the University, and beyond. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).**

Evaluate table 16 from the Office of Planning Analysis for SCH by student department affiliation on fall census day.

a. Provide a brief assessment of the service the Program provides. Comment on percentage of SCH taken by majors and non-majors, nature of Program in terms of the service it provides to other University programs, faculty service to the institution, and beyond.

Provide assessment here: The chemistry department provides a large amount of service to students in other programs in the university. This is predominantly due to a few factors. All students who plan to apply to medical school, as well as a number of other health-related professional schools, must take at least 20 SCH in the chemistry department (10 SCH of General Chemistry and 10 SCH of Organic Chemistry). Increasingly, medical schools are requiring biochemistry, as well, which is reflected in the fact that we have started offering Chem 661 (Introductory Biochemistry) in both Fall and Spring semesters. All engineering majors at WSU are required to take the first semester of General Chemistry (Chem 211, 5 SCH), while students in Biomedical Engineering take 16 SCH (10 SCH of General Chemistry, 3 SCH of Elementary Organic Chemistry – a course developed and taught explicitly for this program, and 3 SCH of Introductory Biochemistry). All nursing majors are required to take Chem 103 or Chem 211 and exercise science majors take Chem 103. Finally, 10 SCH of General Chemistry is required by students in the other natural science majors (biology, physics, and geology) – students majoring in biology also take 10 SCH of Organic Chemistry. The remaining upper division classes and all graduate-level classes are taken almost exclusively by chemistry undergraduate and graduate students. As a result, the data show that, consistently, over 80% of courses offered by the chemistry department are taken by students other than chemistry majors.

6. Report on the Program's goal (s) from the last review. List the goal (s), data that may have been collected to support the goal, and the outcome. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

(For Last 3 FYs)	Goal (s)	Assessment Data Analyzed	Outcome
	Improve program assessment	End-of-course assessment exams Assessment of written report	Assessment exams are now being administered in all appropriate classes. For the most part, students are showing acceptable outcomes based on these exams. We have begun analyzing appropriate rubrics for this process.
	Improve tracking of undergraduate alumni	Alumni survey	A survey was sent out by email to all alumni for whom the university had contact information, as well as by mail in the departmental newsletter. Approximately 50 people responded. We will make a second attempt at contacting alumni.
	Increase number of chemistry faculty to at least 14 (from current 11).	Search for new faculty member.	We advertised for the Erach Talaty Distinguished Professor of Chemistry. Three candidates were interviewed and an offer has been made. Successfully filling this position will bring us to 12 faculty members.

7. Summary and Recommendations

a. Set forth a summary of the report including an overview evaluating the strengths and concerns. List recommendations for improvement of each Program (for departments with multiple programs) that have resulted from this report (relate recommendations back to information provided in any of the categories and to the goals and objectives of the program as listed in 1e). Identify three year goal (s) for the Program to be accomplished in time for the next review.

Provide assessment here:

Overall, the Department of Chemistry continues to be a very strong program from the standpoint of both teaching and research. Our faculty, in collaboration with graduate and undergraduate students, are carrying out frontier level research, publishing at a high rate in premier journals, presenting their research at major conferences, and obtaining external funding for their research programs. Our undergraduate students are performing well compared to national norms on course-specific assessment

examinations and are well-prepared, upon graduation, to obtain employment in a chemistry-related field or to pursue advanced professional or graduate degrees. Our graduate students have been successful in moving on to industrial, academic, or postdoctoral positions. The department successfully occupies a middle ground between four-year or masters-only institutions and major research institutions. With a successful PhD program and external funding, we are able to offer our graduate students the opportunity to engage in the highest level of scholarly research; our undergraduate students are exposed to the same and are afforded the chance to experience a true research experience and use state-of-the-art instrumentation. At the same time, our undergraduate classes are, for the most part, taught by tenured and tenure-track faculty and the size of our research groups are small enough to allow more personalized attention from the faculty member to the student researchers.

The major concerns regarding the department continue to be (i) the decreasing availability of federal grant money and (ii) the increasing competition for new faculty members. The vast majority of external funding received by chemistry faculty members comes from federal agencies, i.e., NIH and NSF. These funds are increasingly difficult to obtain for researchers across the country at all levels. We have been fortunate to have access to programs in Kansas such as NIH-funded COBRE and KINBRE, and NSF-funded EPSCoR. We have also leveraged funding from local industry and we have continued to be successful in receiving major NIH and NSF grants. However, the present economic conditions suggest that budgets for these and other federal funding agencies will, at best, be flat for the foreseeable future. Our department remains understaffed in terms of tenured and tenure-track faculty, due to an inability from a college and university standpoint to re-staff after a significant number of departures in past years. New faculty who began during or just prior to the previous review period have reached a good level of productivity and grant success and our established faculty continue to be very productive.

Goals for the next three years include:

1 - Continue to improve program assessment. Our assessment of student learning with regards to content, using ACS examinations, is working well. We continue to explore the best ways to assess other aspects of student learning.

2 - Continue to improve tracking of undergraduate alumni. Our alumni survey produced limited return, although it was in line with expectations from such a survey. We will make another attempt at reaching out to alumni through our next departmental newsletter.

3 - Work towards returning the staffing level of the department to 14 or 15 faculty members. Our current search for the Erach Talaty Distinguished Professor is in progress – if successful it will bring us to 12 faculty members. One faculty member is retiring after AY19 and will need to be replaced.

4 – Develop honors curriculum. We have been in consultation with the Cohen Honors College regarding the development of an honors science track including honors General Chemistry. We hope to begin this in the fall with the establishment of an honors lab section for Chem 211.